REMARKS/ARGUMENTS

Applicants thank Examiner Nguyen for the helpful and courteous discussion of October 8, 2003. During the discussion, Applicants' U.S. representative pointed out that contrary to the Office's statement, one of the references (Dye) does not disclose alkaline earth thioaluminates. The Examiner suggested submitting a response to the Advisory Action of October 2, 2003, distinctly pointing out that the Dye reference does not disclose alkaline earth thioaluminates.

Claim 15 has been amended to require the presence of an underlying lead-containing structure in the claimed EL phosphor multilayer thin film and further that the dielectric thin film is present on the underlying structure. Lead is known to have high ion migration capability and may move into the light emitting layer (e.g., phosphor thin film) and exert considerable influence on the light emission properties of the phosphor thin film (page 6, lines 4-16).

New dependent Claim 22 requires that the dielectric thin film interpose the phosphor thin film and the underlying structure.

In the Office Action of May 16, 2003, the Office rejected Claims 15 and 17-21 under 35 U.S.C. § 102(b) in view of a patent to Dye (U.S. 5,834,053). In the Advisory Action the Office pointed to Figure 1 and column 3, lines 1-33 of the Dye patent as evidence that Dye discloses alkaline earth thioaluminates. Applicants traverse the rejection on the grounds that Dye nowhere discloses phosphor thin films containing alkaline earth thioaluminates.

Figure 1 of Dye is reproduced on a separate page for convenience. The text from column 3, lines 1-33 of Dye is reproduced below:

> The electroluminescent phosphor layer is comprised of a group II metal thiogallate with a rare earth dopant. The general chemical formula is RGa_2S_4:Ce, where R is selected from the group of magnesium, calcium, strontium, barium or

zinc, preferably calcium, strontium and barium. Cerium (Ce) serves as an activator dopant. For blue emission in a thin film electroluminescent device, cerium is the preferred activator dopant. For other color emissions, other activator dopants such as europium or terbium may be used. The activator dopant is generally added to the group II metal thiogallate in amounts of from about 1 to about 10 atomic percent, preferably from about 2 to about 8 atomic percent.

A thin film electroluminescent panel in accordance with the present invention can include a glass substrate which supports a transparent conducting material such as indium tin oxide (ITO) electrode layer. Deposited on top of this electrode layer is a layer of a dielectric material such as barium □antalite ($BaTa_2O_6$), strontium titanate ($SrTiO_3$), a multilayer structure of Al_2O_3 or TiO_2 ((Al_2O_3 /TiO_2) including several layers to make up the desired thickness, such multilayer dielectric hereinafter referred to as ATO) or barium titanate ($BaTiO_3$), the layer of dielectric material having a thickness of around 3000 Å. A layer of zinc sulfide (ZnS) which is between 100 Å and 500 Å thick is deposited on top of the dielectric layer. Next, a layer of the thiogallate phosphor is deposited atop this ZnS layer. The thiogallate phosphor layer is formed by chemical vapor deposition from metallo-organic or organometallic precursors. The thiogallate layer can be covered with a thicker ZnS layer of between about 1000 Å to about 2000 Å thick. Optionally, no second layer of ZnS is needed. A second dielectric insulator layer about 3000 Å thick is placed atop the second ZnS layer. The top rear electrode layer is formed of electrodes made of aluminum.

Figure 1 is reproduced on the next page for convenience.

Figure 1 of Dye

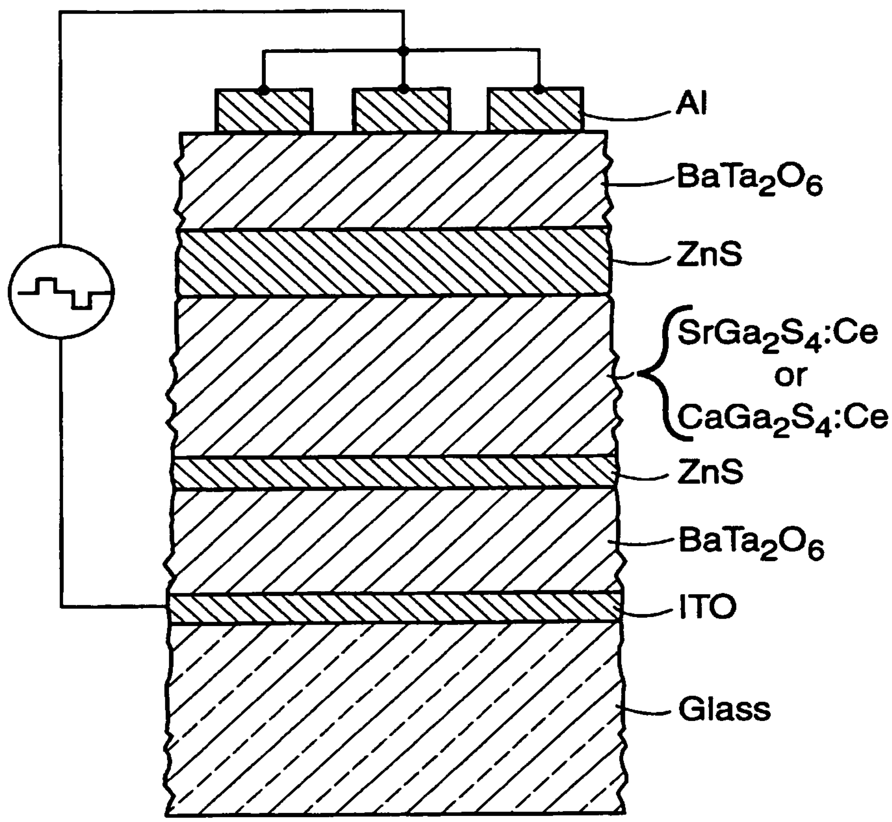

Fig. 1

As is clear from Figure 1 and the text cited by the Office, Dye does not disclose alkaline earth thioaluminates. Dye instead discloses alkaline earth thiogallates. A thioaluminate and a thiogallate are different because a thiogallate may be a formula MGa_2S_4 whereas a thioaluminate may be a formula MAl_2S_4; where M is an alkaline earth metal. Gallium (Ga) and aluminum (Al) are different elements that appear in different positions in the periodic table.

Although Dye discloses that aluminum may be present in the prior art device, this aluminum is present in the form of aluminum oxide (Al_2O_3) (column 3, line 18) or elemental aluminum as an electrode on top of the prior art device (see Figure 1).

Applicants respectfully request the withdrawal of the rejection of Claims 15 and 17-21 as anticipated under 35 U.S.C. § 102(b) in view of the patent to Dye.

The Office rejected Claim 16 as obvious in view of a combination of the patent to Dye and a publication to Miura (Jpn. J. Appl. Phys., Vol. 38 (1999), Pt. 2. No. 11 B, pp. L1291-L1292).

The Office has asserted that Miura describes an alkaline earth thioaluminate. Miura discloses an electroluminescent device that contains, in the following order, an insulating layer (Ta_2O_5)/a buffer layer (ZnS)/a phosphor layer/a buffer layer (ZnS)/an insulating layer (Ta_2O_5)/an electrode (indium tin oxide). Nowhere in Miura is it disclosed that an underlying lead-containing structure should be present on the prior art dielectric layer as presently claimed. For purposes of argument, if one were to consider the insulating layer (Ta_2O_5) layer of Miura as a dielectric layer it is immediately evident that this hypothetical dielectric layer is not directly adjacent to the prior art glass substrate but instead is separated from the glass

substrate by an indium tin oxide (electrode) layer.[1] Nowhere in Miura is it disclosed that the Ta_2O_5 insulating layer may contain lead and nowhere in Miura is it disclosed that the electrode layer must contain lead.

The presently-claimed invention requires that a phosphor thin film and a dielectric thin film are stacked one upon another and that the dielectric layer is present on an underlying lead-containing layer. The combination of the dielectric thin film and the alkaline earth thioaluminate phosphor thin film is an important feature of the claimed invention. The presence of a dielectric thin film such as $BaTiO_3$ in the claimed EL phosphor thin film may protect the alkaline earth thioaluminate phosphor thin film from the ingress of elements such as lead from other layers (page 6, lines 2-4). Such ingress of elements into the thioaluminate phosphor layer may be accelerated for alkaline earth thioaluminates because a thioaluminate phosphor has a high crystallization temperature (page 6, lines 21-24).

Elements ingressing from other layers may negatively impact the phosphor layer performance. This effect is demonstrated in Example 1 of the present specification (pages 17-19). In the EL device of Example 1 an alkaline earth thioaluminate phosphor layer is located between two dielectric layers ($BaTiO_3$). This EL device is able to provide a luminance of 650 cd/m^2 (page 18, line 34).

The luminance performance of the inventive example may be compared with a comparative example (page 19, lines 3-9). The comparative example is prepared in the same manner as the inventive example however no dielectric layer ($BaTiO_3$) is present. The luminance achieved with this EL device is only 100 cd/m^2 (page 19, line 6).

The difference in the luminance performance of the inventive example and the comparative example may be due to the ingress of undesired elements into the alkaline earth

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[1] Applicants do not assert that the insulating layer (Ta_2O_5) of Miura is a dielectric thin film. The prior art insulating layer does not meet the present requirements for a dielectric thin film (e.g., alkaline earth-containing oxide).

thioaluminate phosphor of the comparative example. In the inventive example no lead (Pb) element is detected by Auger analysis. However, in the comparative example, Pb is detected in the phosphor thin film.

Not only does the dielectric thin film serve to protect the phosphor layer from the ingress of unwanted elements, the dielectric layer functions as a source of oxygen for ingressing into the phosphor layer. Such an ingress of oxygen may positively effect the luminance performance of the alkaline earth thioaluminate (page 19, lines 17-23).

The comparison of Example 1 and the Comparative Example above serves to demonstrate that improved luminance performance may be achieved when a phosphor thin film that contains an alkaline earth thioaluminate is stacked upon a dielectric layer. This improvement in luminance is due at least in part to the inhibition of the ingress of the unwanted elements into the phosphor layer and the concomitant ingress of oxygen into the alkaline earth thioaluminate layer.

Each of the Dye and Miura references disclose phosphor layers that are bounded by ZnS buffer layers (see Figure 2 of Miura and Figures 1 and 2 of Dye). A ZnS buffer layer is expected to inhibit the ingress of oxygen into the phosphor layer in the prior art references since an oxygen-containing dielectric layer is not in contact with the phosphor layer. Therefore in Dye and Miura, the ingress of both unwanted elements and oxygen into the phosphor layer is expected to be inhibited or even completely prevented. Therefore, Dye and Miura disclose EL devices that are different from the claimed device because in the claimed device oxygen ingress into the phosphor layer occurs from the dielectric layer and may provide improved performance.

Applicants submit the claimed invention is not obvious in view of the combination of Dye and Miura on the grounds that Dye and Miura describe EL devices of an architecture that would inhibit and/or prevent the ingress of oxygen into the phosphor layer.

Applicants submit that the amendment to the claims places all now-pending claims into condition for allowance. Applicants respectfully request the withdrawal of the rejections and the passage of all now-pending claims to Issue.

Respectfully submitted,

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